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Examiner

**EGWIM, Kelechi Chidi**

Group Art Unit

**1796**Invention: **AUXILIARY FOR FORMING FINE PATTERN AND PROCESS FOR PRODUCING THE SAME**

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CLAIMS

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[Claim(s)]

[Claim 1] It is the metal membrane pattern formation approach including at least six processes. The 1st process After carrying out the laminating of the 1st metal membrane and 2nd metal membrane and forming them on a substrate, it is the process which makes a photoresist frame adhere on the 2nd metal membrane. The 2nd process It is the process which makes the 3rd metal membrane adhere to the inside and outside divided with said photoresist frame of the front face of said 2nd metal membrane. The 3rd process It is the process which removes said photoresist frame. The 4th process It is the process processed so that said 2nd metal membrane may be removed in the remains of clearance of said photoresist frame and it may leave said 1st metal membrane. The clearance means of said 2nd metal membrane is chemical selective etching. The 5th process It is the process to which a photoresist is made to adhere so that the 3rd metal membrane which filled said remains of clearance and was surrounded by said remains of clearance may be covered. The 6th process The metal membrane pattern formation approach which is a process of removing the 3rd metal membrane, 2nd metal membrane, 1st outside metal membrane, and outside photoresist of a photoresist.

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[Translation done.]

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]****[0001]**

**[Industrial Application]** This invention relates to the formation approach of a metal membrane pattern that a high-degree-of-accuracy pattern is required, like the pole piece of the thin film magnetic head.

**[0002]**

**[Description of the Prior Art]** When forming pole piece by plating, the 1st metal membrane used as a glue line is made to adhere on the surface of a substrate, the laminating of the 2nd metal membrane used as a substrate layer is carried out to the front face of this 1st metal membrane, and the 3rd metal membrane used as pole piece is made to adhere to the front face of this 2nd metal membrane by plating in the thin film magnetic head. Although the high-degree-of-accuracy pattern formation technique called a photolithography is applied in the pattern formation of the 3rd metal membrane, chemical etching down stream processing is contained in the pattern formation technique by the photolithography, the 1st metal membrane and 2nd metal membrane are etched across a required field, and an undercut may be produced. As a conventional technique for avoiding an undercut, the technique indicated by JP,57-120675,A is well-known.

**[0003]** In this conventional technique, ion . mealing removes to the 1st metal membrane which is on the surface of a substrate. For this reason, the thickness of the 3rd metal membrane from which the time amount by which the 3rd metal membrane is put to mealing should become long, and should serve as pole piece decreased, and there were troubles, like the damage to receive becomes large.

**[0004]** There is JP,64-47883,A as an example of well-known reference aiming at this trouble solution. In this advanced technology, in the remains of clearance of a photoresist frame, the 2nd metal membrane removes, and the 1st metal membrane is processed so that it may leave. Although ion . mealing performs clearance of the 2nd metal membrane, since the 1st metal membrane is processed so that it may leave, the time amount by which the 3rd metal membrane is put to ion . mealing becomes short. For this reason, the thickness reduction and the damage of the 3rd metal membrane by ion . mealing can be reduced.

**[0005]**

**[Problem(s) to be Solved by the Invention]** However, in invention indicated by JP,64-47883,A, since ion . mealing had removed the 2nd metal membrane, the thickness reduction and the damage of the 3rd metal membrane used as pole piece were thoroughly nonavoidable.

**[0006]** Then, the technical problem of this invention is offering the metal membrane pattern formation approach thickness reduction and the damage to receive of the 3rd metal membrane which should serve as pole piece being avoided certainly.

**[0007]**

**[Means for Solving the Problem]** The metal membrane pattern formation approach concerning this invention for the technical-problem solution mentioned above It is the metal membrane pattern formation approach including at least six processes. The 1st process After carrying out the laminating of the 1st metal membrane and 2nd metal membrane and forming them on a substrate, it is the process which makes a photoresist frame adhere on the 2nd metal membrane. The 2nd process It is the process which makes the 3rd metal membrane adhere to the inside and outside divided with said photoresist frame of the front face of said 2nd metal membrane. The 3rd process It is the process which removes said photoresist frame. The 4th process It is the process processed so that said 2nd metal membrane may be removed in the remains of clearance of said photoresist frame and it may leave said 1st metal membrane. The clearance means of said 2nd metal membrane is chemical selective etching. The 5th process As the 3rd metal membrane which filled said remains of clearance and was surrounded by said remains of clearance is covered, it is the process to which a

photoresist is made to adhere, and the 6th process is a process which removes the 3rd metal membrane, 2nd metal membrane, 1st outside metal membrane, and outside photoresist of a photoresist.

[0008]

[Function] Since the 4th process is a process processed so that the 2nd metal membrane may be removed in the remains of clearance of a photoresist frame and it may leave the 1st metal membrane and the clearance means of the 2nd metal membrane is chemical selective etching, the 3rd metal membrane is not put to ion . mealing. For this reason, the thickness reduction and the damage of the 3rd metal membrane by ion . mealing are avoidable.

[0009] Moreover, since the remains of clearance of a photoresist frame are filled by the photoresist, the 1st metal membrane serves as structure which covered the part extended from the 2nd metal membrane bottom by the photoresist. For this reason, when chemical etching removes the 3rd metal membrane and 2nd metal membrane, the etching by the etching agent is less than the 1st metal membrane which remains in the part extended by the photoresist bottom and is located in the 2nd metal membrane bottom. Therefore, the adder cut of the 1st metal membrane is avoidable. Moreover, the 1st metal membrane is formed according to the construction material which has etching-proof nature to the etching agent used when removing the 3rd metal membrane, and the undercut of the 1st metal membrane can be avoided.

[0010]

[Example] Drawing 1 - drawing 9 are drawings showing the metal membrane pattern formation process concerning this invention.

[0011] The 5th process and drawing 7 or subsequent ones correspond [ the process the process the process the process the process shown by drawing 1 and drawing 2 was indicated to be to the 1st process and drawing 3 was indicated to be to the 2nd process and drawing 4 was indicated to be to the 3rd process and drawing 5 was indicated to be to the 4th process and drawing 6 ] to the 6th process, respectively. First, the laminating of the 1st metal membrane 2 and 2nd metal membrane 3 is carried out, and they are made to adhere with means, such as plating, on a substrate 1 at the 1st process, as shown in drawing 1 . The construction material of the substrate 1 in the case of constituting the thin film magnetic head, the 1st metal membrane 2, and the 2nd metal membrane 3 is common knowledge. typical -- a substrate 1 -- aluminum2O3.TiC etc. -- it is constituted and has insulator layers, such as 2Oaluminum3 film, on a front face. The 1st metal membrane 2 consists of titanium etc., and the 2nd metal membrane 3 consists of a nickel system alloy, chromium, etc. Next, the photoresist frame 4 is made to adhere on the 2nd metal membrane 3, as shown in drawing 2 . The photoresist frame 4 is made to adhere so that it may become a pattern corresponding to the pattern which it is going to obtain eventually.

[0012] The 3rd metal membrane 5 is made to adhere to the inside and outside divided with the photoresist frame 4 of the front face of the 2nd metal membrane 3 by plating at the 2nd process, as shown in drawing 3 . This 3rd metal membrane 5 is formed as magnetic thin films, such as a permalloy, in the thin film magnetic head.

[0013] At the 3rd process, as shown in drawing 4 , the photoresist frame 4 is removed and the 2nd metal membrane 3 is exposed.

[0014] The 4th process is the description part of this invention. At the 4th process, as shown in drawing 5 , in the remains 41 of clearance of the photoresist frame 4, the 2nd metal membrane 3 removes, and it processes the 1st metal membrane 2 so that it may leave. When the 1st metal membrane 2 was removed, ion . mealing processing was performed conventionally. For this reason, as mentioned above, the thickness reduction and the damage of the 3rd metal membrane 5 by ion . mealing were thoroughly nonavoidable. In this invention, not ion mealing but chemical selective etching performs the 2nd metal membrane 3. Therefore, the 3rd metal membrane 5 is not put to ion . mealing. For this reason, the thickness reduction and the damage of the 3rd metal membrane 5 by ion . mealing are thoroughly avoidable. Chemical selective etching is performed by choosing the etching reagent according to the construction material of the 2nd metal membrane 3. The example of representation of the etching reagent which was suitable when the 2nd metal membrane 3 became with a nickel system alloy is alkylbenzene sulfonic acid.

[0015] Then, a photoresist 6 is made to adhere at the 5th process, so that the 3rd metal membrane 3 which filled the remains 41 of clearance and was surrounded by the remains 41 of clearance as shown in drawing 6 may be covered.

[0016] Next, at the 6th process, as shown in drawing 7 , the 3rd outside metal membrane 5 and 2nd outside metal membrane 3 of a photoresist 6 are removed. In this case, since the 1st metal membrane 2 has the part 21 extended by the photoresist 6 bottom from under the 2nd metal membrane 2, when chemical etching removes the 3rd metal membrane 5 and 2nd metal membrane 3, the etching of the 1st metal membrane 2 remains in the part 21 extended by the photoresist 6 bottom, and it does not attain to the part located in the 2nd metal membrane 3 bottom. Therefore, the adder cut of the 1st metal membrane 2 is avoidable. Moreover, etching agent FeCl 3 used when the 1st metal membrane 2 is formed with titanium, and removing the 3rd metal membrane 5 which becomes by the permalloy Since the

receiving etching-proof nature is securable, the undercut of the 1st metal membrane 2 is avoidable also from this field. [0017] Then, as shown in drawing 8, a photoresist 6 is removed, next as shown in drawing 9, the 1st metal membrane 2 is removed, and the last pattern is obtained.

[0018]

[Effect of the Invention] According to this invention, the following effectiveness is acquired as stated above.

(a) The 4th process is a process processed so that the 2nd metal membrane may be removed in the remains of clearance of a photoresist frame and it may leave the 1st metal membrane, and since the clearance means of the 2nd metal membrane is chemical selective etching, it can offer the metal membrane pattern formation approach that the thickness reduction and the damage of the 3rd metal membrane by ion . mealing can be avoided thoroughly.

(b) Since the remains of clearance of a photoresist frame are filled by the photoresist, the metal membrane pattern formation approach that the undercut of the 1st metal membrane can be avoided can be offered.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] -

[Drawing 9] It is drawing showing the process of the metal membrane pattern formation approach concerning this invention.

[Description of Notations]

1 Substrate

2 1st Metal Membrane

3 2nd Metal Membrane

4 Photoresist Frame

5 3rd Metal Membrane

6 Photoresist

41 The Remains of Clearance of Photoresist Frame

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CORRECTION OR AMENDMENT

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 [Category partition] The 4th partition of the 3rd category  
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 [Annual volume number] Open patent official report 6-812  
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C23F 1/00 102  
 G03F 7/26  
 G11B 5/31

[FI]

C23F 1/00 102  
 G03F 7/26  
 G11B 5/31 C

[Procedure amendment]

[Filing Date] August 30, Heisei 11 (1999. 8.30)

[Procedure amendment 1]

[Document to be Amended] Description

[Item(s) to be Amended] 0003

[Method of Amendment] Modification

[Proposed Amendment]

[0003] In this conventional technique, ion milling removes to the 1st metal membrane which is on the surface of a substrate. For this reason, the thickness of the 3rd metal membrane from which the time amount by which the 3rd metal membrane is put to milling should become long, and should serve as pole piece decreased, and there were troubles, like the damage to receive becomes large.

[Procedure amendment 2]

[Document to be Amended] Description

[Item(s) to be Amended] 0004

[Method of Amendment] Modification

[Proposed Amendment]

[0004] There is JP,64-47883,A as an example of well-known reference aiming at this trouble solution. In this advanced technology, in the remains of clearance of a photoresist frame, the 2nd metal membrane removes, and the 1st metal membrane is processed so that it may leave. Although ion milling performs clearance of the 2nd metal membrane, since the 1st metal membrane is processed so that it may leave, the time amount by which the 3rd metal membrane is put to ion milling becomes short. For this reason, the thickness reduction and the damage of the 3rd metal membrane by ion milling can be reduced.

[Procedure amendment 3]

[Document to be Amended] Description

[Item(s) to be Amended] 0005  
 [Method of Amendment] Modification  
 [Proposed Amendment]  
 [0005]

[Problem(s) to be Solved by the Invention] However, in invention indicated by JP,64-47883,A, since ion milling had removed the 2nd metal membrane, the thickness reduction and the damage of the 3rd metal membrane used as pole piece were thoroughly nonavoidable.

[Procedure amendment 4]  
 [Document to be Amended] Description  
 [Item(s) to be Amended] 0008  
 [Method of Amendment] Modification  
 [Proposed Amendment]  
 [0008]

[Function] Since the 4th process is a process processed so that the 2nd metal membrane may be removed in the remains of clearance of a photoresist frame and it may leave the 1st metal membrane and the clearance means of the 2nd metal membrane is chemical selective etching, the 3rd metal membrane is not put to ion milling. For this reason, the thickness reduction and the damage of the 3rd metal membrane by ion milling are avoidable.

[Procedure amendment 5]  
 [Document to be Amended] Description  
 [Item(s) to be Amended] 0009  
 [Method of Amendment] Modification  
 [Proposed Amendment]

[0009] Moreover, since the remains of clearance of a photoresist frame are filled by the photoresist, the 1st metal membrane serves as structure which covered the part extended from the 2nd metal membrane bottom by the photoresist. For this reason, when chemical etching removes the 3rd metal membrane and 2nd metal membrane, the etching by the etching agent is less than the 1st metal membrane which remains in the part extended by the photoresist bottom and is located in the 2nd metal membrane bottom. Therefore, the undercut of the 1st metal membrane is avoidable. Moreover, the 1st metal membrane is formed according to the construction material which has etching-proof nature to the etching agent used when removing the 3rd metal membrane, and the undercut of the 1st metal membrane can be avoided.

[Procedure amendment 6]  
 [Document to be Amended] Description  
 [Item(s) to be Amended] 0014  
 [Method of Amendment] Modification  
 [Proposed Amendment]

[0014] The 4th process is the description part of this invention. At the 4th process, as shown in drawing 5, in the remains 41 of clearance of the photoresist frame 4, the 2nd metal membrane 3 removes, and it processes the 1st metal membrane 2 so that it may leave. When the 1st metal membrane 2 was removed, ion milling processing was performed conventionally. For this reason, as mentioned above, the thickness reduction and the damage of the 3rd metal membrane 5 by ion milling were thoroughly nonavoidable. In this invention, not ion milling but chemical selective etching performs the 2nd metal membrane 3. Therefore, the 3rd metal membrane 5 is not put to ion milling. For this reason, the thickness reduction and the damage of the 3rd metal membrane 5 by ion milling are thoroughly avoidable. Chemical selective etching is performed by choosing the etching reagent according to the construction material of the 2nd metal membrane 3. The example of representation of the etching reagent which was suitable when the 2nd metal membrane 3 became with a nickel system alloy is alkylbenzene sulfonic acid.

[Procedure amendment 7]  
 [Document to be Amended] Description  
 [Item(s) to be Amended] 0016  
 [Method of Amendment] Modification  
 [Proposed Amendment]

[0016] Next, at the 6th process, as shown in drawing 7, the 3rd outside metal membrane 5 and 2nd outside metal membrane 3 of a photoresist 6 are removed. In this case, since the 1st metal membrane 2 has the part extended by the photoresist 6 bottom from under the 2nd metal membrane 3, when chemical etching removes the 3rd metal membrane 5 and 2nd metal membrane 3, the etching of the 1st metal membrane 2 remains in the part extended by the photoresist 6



bottom, and it does not attain to the part located in the 2nd metal membrane 3 bottom. Therefore, the undercut of the 1st metal membrane 2 is avoidable. Moreover, etching agent FeCl<sub>3</sub> used when the 1st metal membrane 2 is formed with titanium, and removing the 3rd metal membrane 5 which becomes by the permalloy Since the receiving etching-proof nature is securable, the undercut of the 1st metal membrane 2 is avoidable also from this field.

[Procedure amendment 8]

[Document to be Amended] Description

[Item(s) to be Amended] 0018

[Method of Amendment] Modification

[Proposed Amendment]

[0018]

[Effect of the Invention] According to this invention, the following effectiveness is acquired as stated above.

(a) The 4th process is a process processed so that the 2nd metal membrane may be removed in the remains of clearance of a photoresist frame and it may leave the 1st metal membrane, and since the clearance means of the 2nd metal membrane is chemical selective etching, it can offer the metal membrane pattern formation approach that the thickness reduction and the damage of the 3rd metal membrane by ion milling can be avoided thoroughly.

(b) Since the remains of clearance of a photoresist frame are filled by the photoresist, the metal membrane pattern formation approach that the undercut of the 1st metal membrane can be avoided can be offered.

[Procedure amendment 9]

[Document to be Amended] Description

[Item(s) to be Amended] Easy explanation of a drawing

[Method of Amendment] Modification

[Proposed Amendment]

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the process of the metal membrane pattern formation approach concerning this invention.

[Drawing 2] It is drawing showing the process which continues after the process shown in drawing 1.

[Drawing 3] It is drawing showing the process which continues after the process shown in drawing 2.

[Drawing 4] It is drawing showing the process which continues after the process shown in drawing 3.

[Drawing 5] It is drawing showing the process which continues after the process shown in drawing 4.

[Drawing 6] It is drawing showing the process which continues after the process shown in drawing 5.

[Drawing 7] It is drawing showing the process which continues after the process shown in drawing 6.

[Drawing 8] It is drawing showing the process which continues after the process shown in drawing 7.

[Drawing 9] It is drawing showing the process which continues after the process shown in drawing 8.

[Description of Notations]

1 Substrate

2 1st Metal Membrane

3 2nd Metal Membrane

4 Photoresist Frame

5 3rd Metal Membrane

6 Photoresist

41 The Remains of Clearance of Photoresist Frame

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[Translation done.]